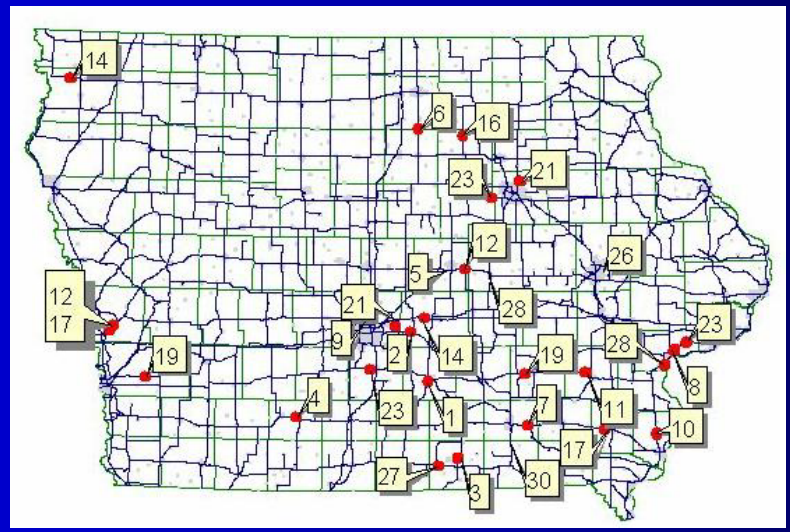
Systematic Identification of High Crash Locations



Iowa Traffic Safety Forum

September 6, 2001

IOWA STATE UNIVERSITY
Becoming the best.

Iowa Department of Transportation

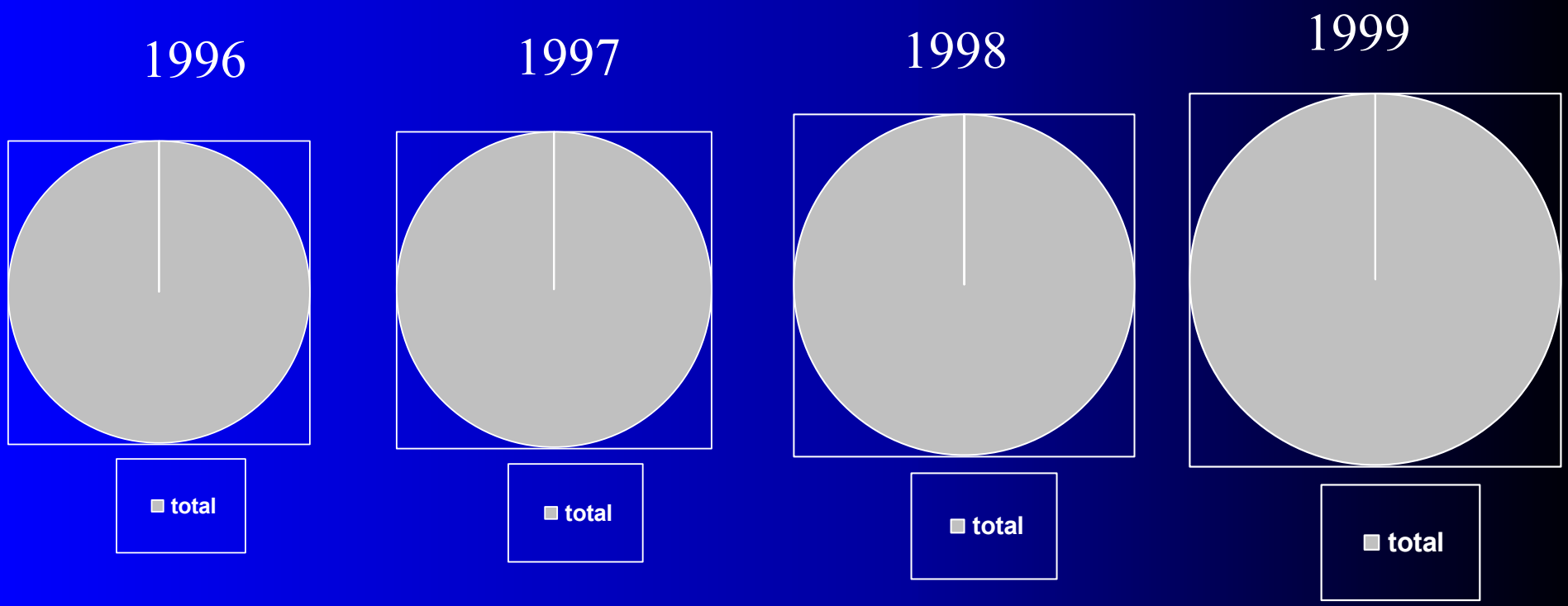
CTRE
Center for Transportation Research and Education

Project Team

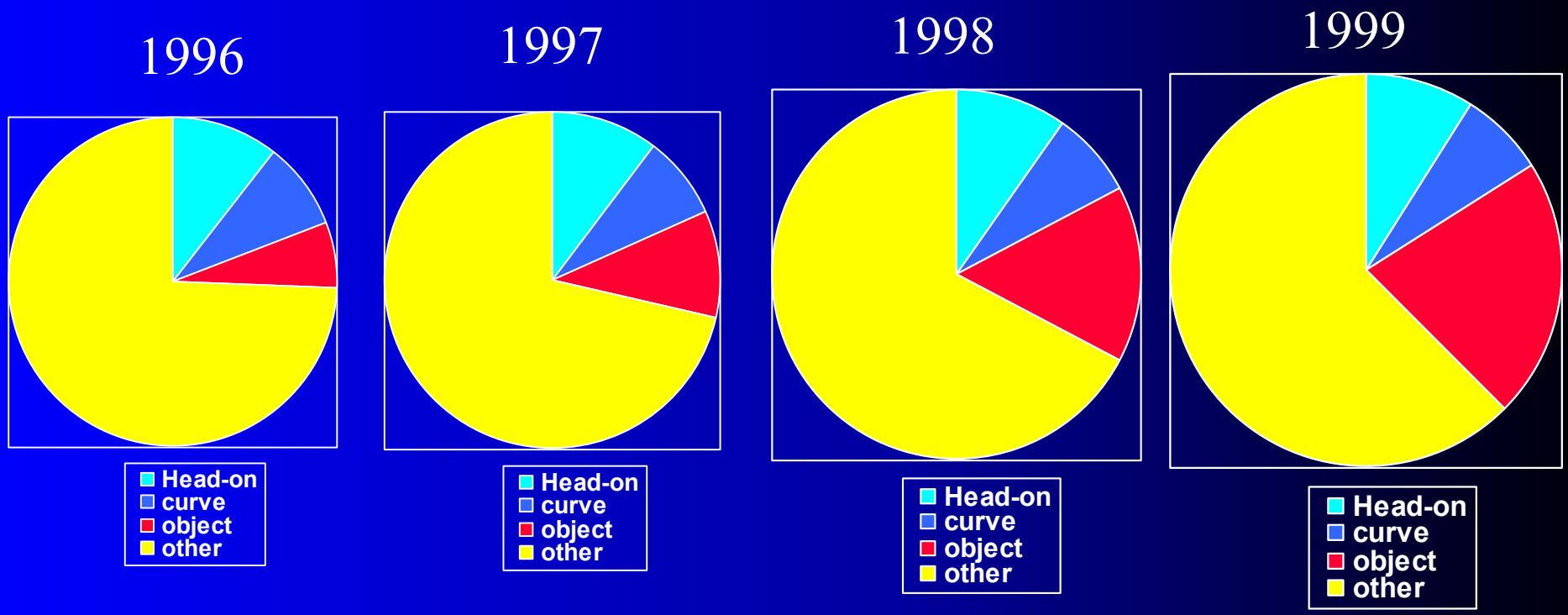
- **Steering Committee:**
  - **Tom Welch (IaDOT, Highway Safety)**
  - **Mark Perington (Snyder & Assoc. – cities)**
  - **Bob Sperry (Webster County)**
  - **Bill Schuman (IaDOT GIS Coordinator)**
- **CTRE Staff: Reg Souleyrette, Ali Kamyab, Keith Knapp, Zach Hans, Aemal Khattak, Raj Basavaraju**

Problem Statement

- **“reactive” engineering consumes resources**
- **Iowa has a method - limited**
- **opportunity: GIS to combine/mine databases and new statistical methods**
- **need a statewide, systematic method to correct poor function PRIOR to loss**
- **make use of analysis and experts**



Current method, looking for worst locations



Proposed method, looking for locations where we can make a difference!

Methodology

- Identify Candidate Problem Types
- Select Problem Types
- Collect Existing Data
- Create New Data (e.g. Curves, Corridors)
- Rank Locations (Frequency, Severity, Rate)
- Perform Statistical Analysis
  - Descriptive, Regression
- Share Results with Field Experts – Iterative process, involving
  - Validation, Education, Adjustment
- Application

Potential Study Topics

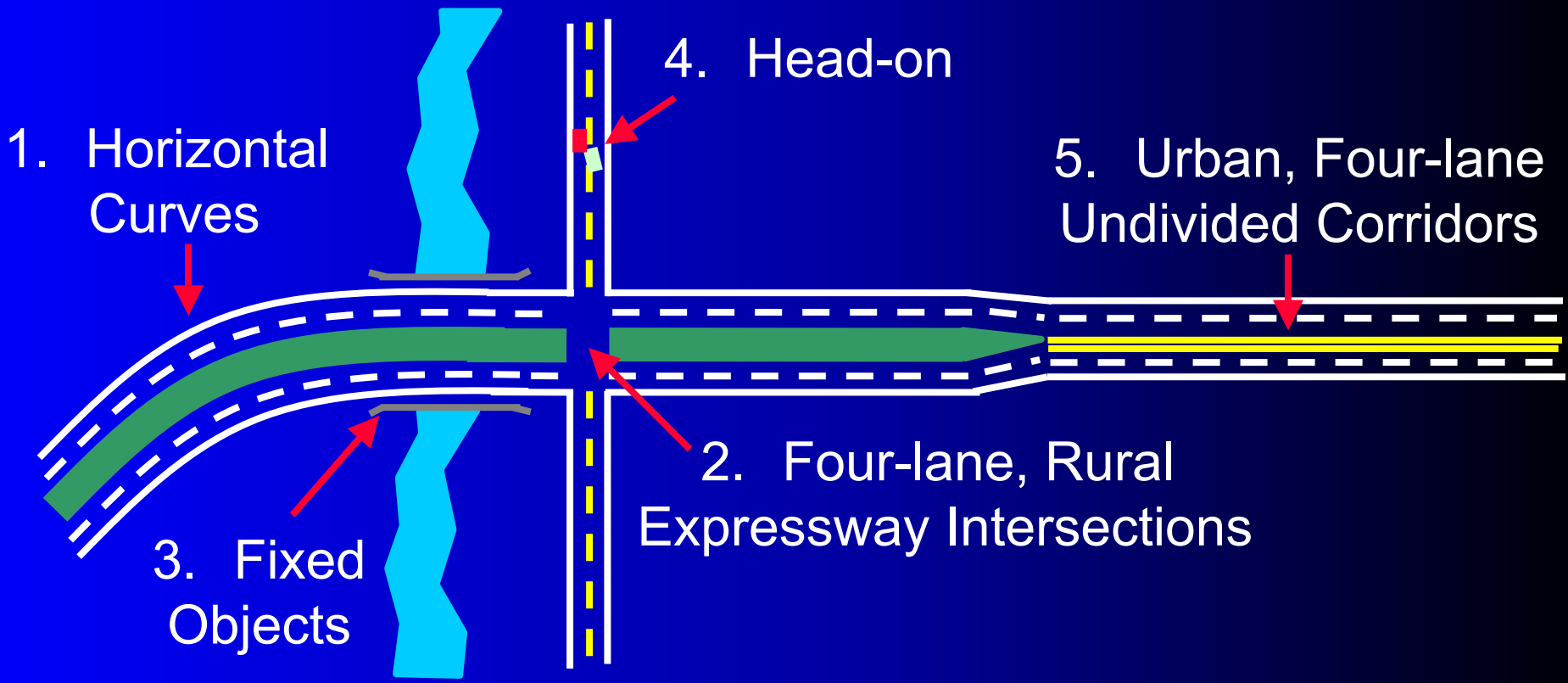
Safety impact of…

- Elderly drivers
- Horizontal curve characteristics (e.g., degree, radius)
- Speed limits of 50 mph or more on expressways
- Traffic volume and traffic mixture
- Speed limit
- Shoulder surface (e.g. paved, unpaved)
- Number of accesses per mile
- Pavement markings
- Signalized turning bays
- Turn lanes in creating traffic turbulence and weaving

High crash locations…

- During Wet weather conditions
- For Run-off-the-road crashes
- For Fixed-object crashes
- At Urban 4-lane undivided roadways
- At Signalized intersections
- At Stop-signed intersections

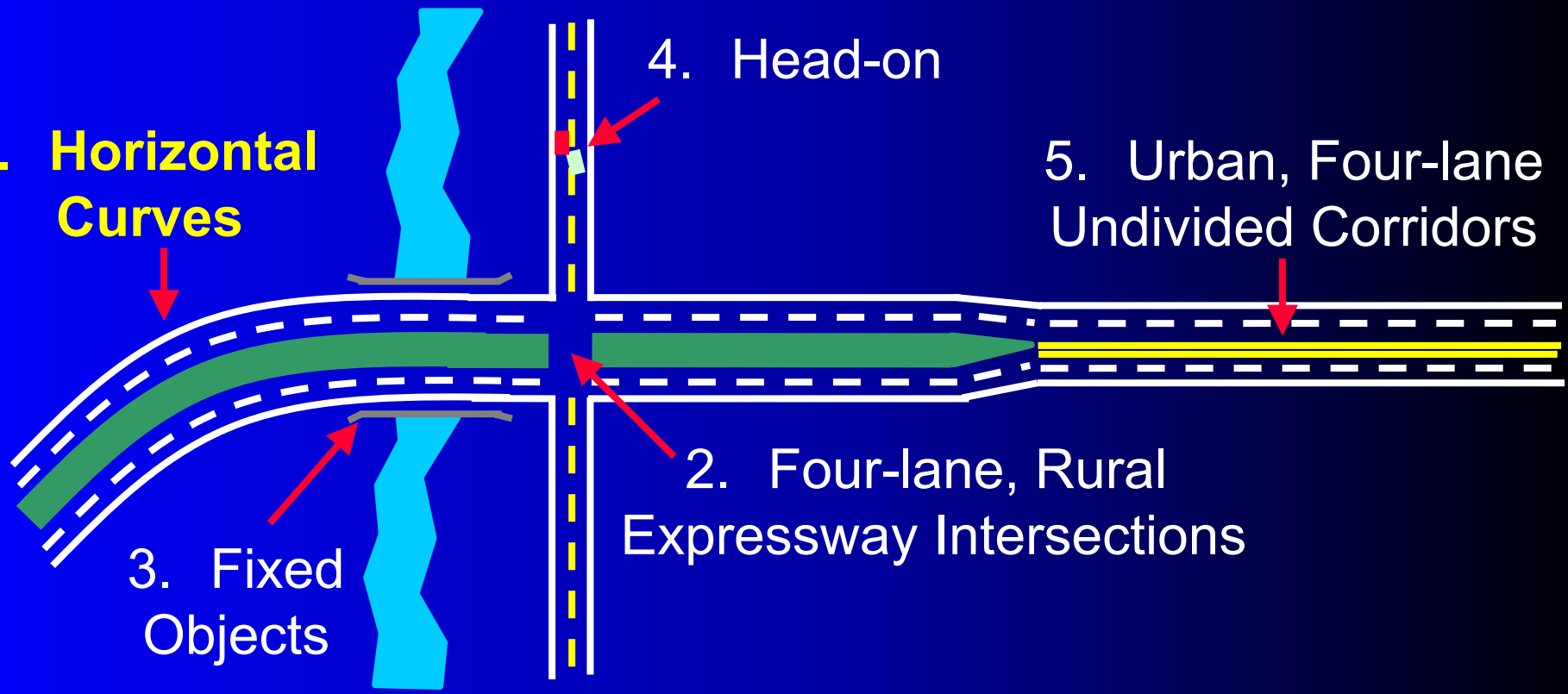
Study Topics



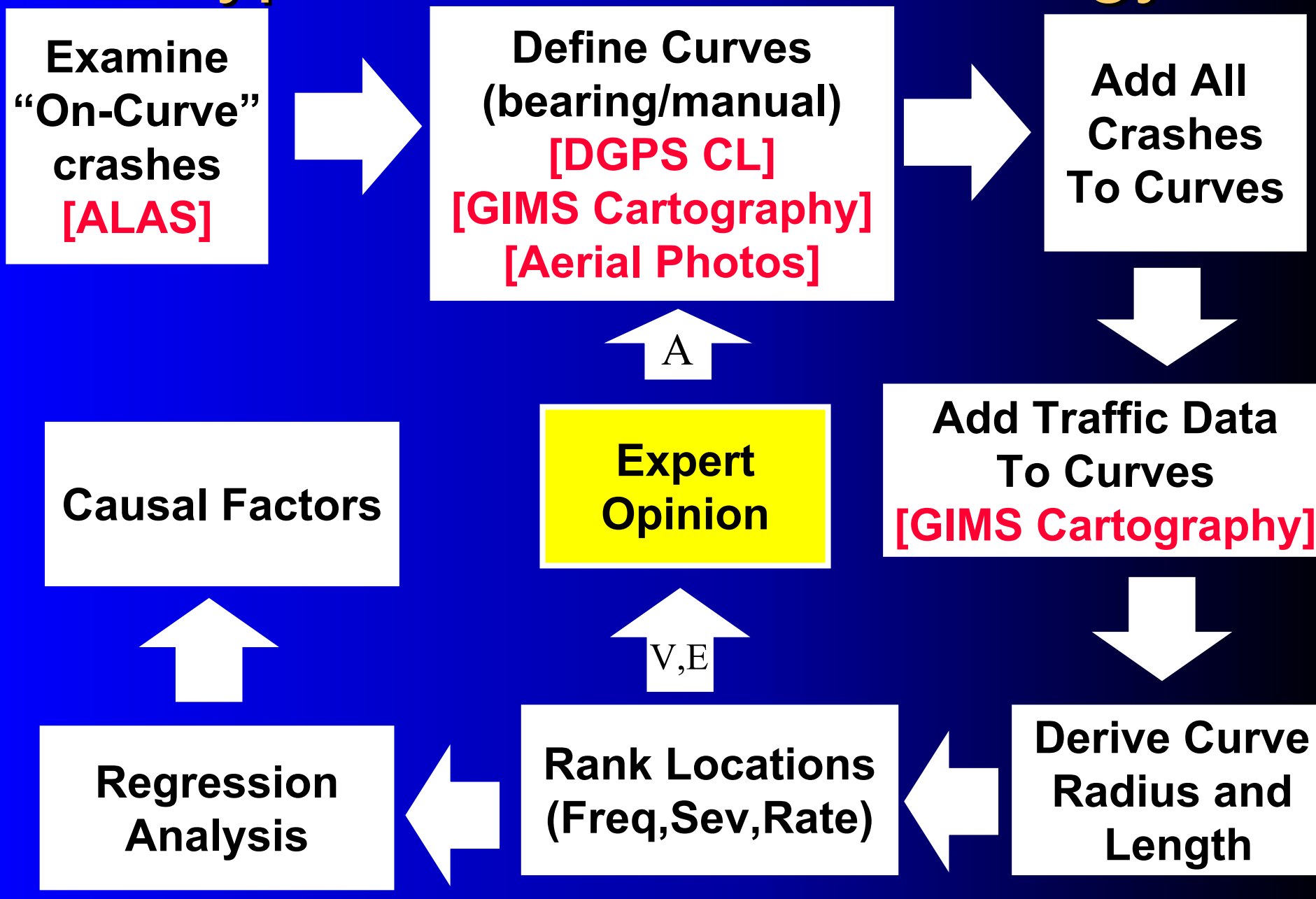
Available Databases

- Roadway centerline graphics and attributes (Geographic Info & Management System, GIMS)
  - Office of Transportation Data
- Crash data (ALAS) - spatial and attribute data
  - GIS-ALAS & Access-ALAS
- Roadware DGPS - driving lane
  - Primary, FAE Secondary & Municipal, Paved?
- Aerial images

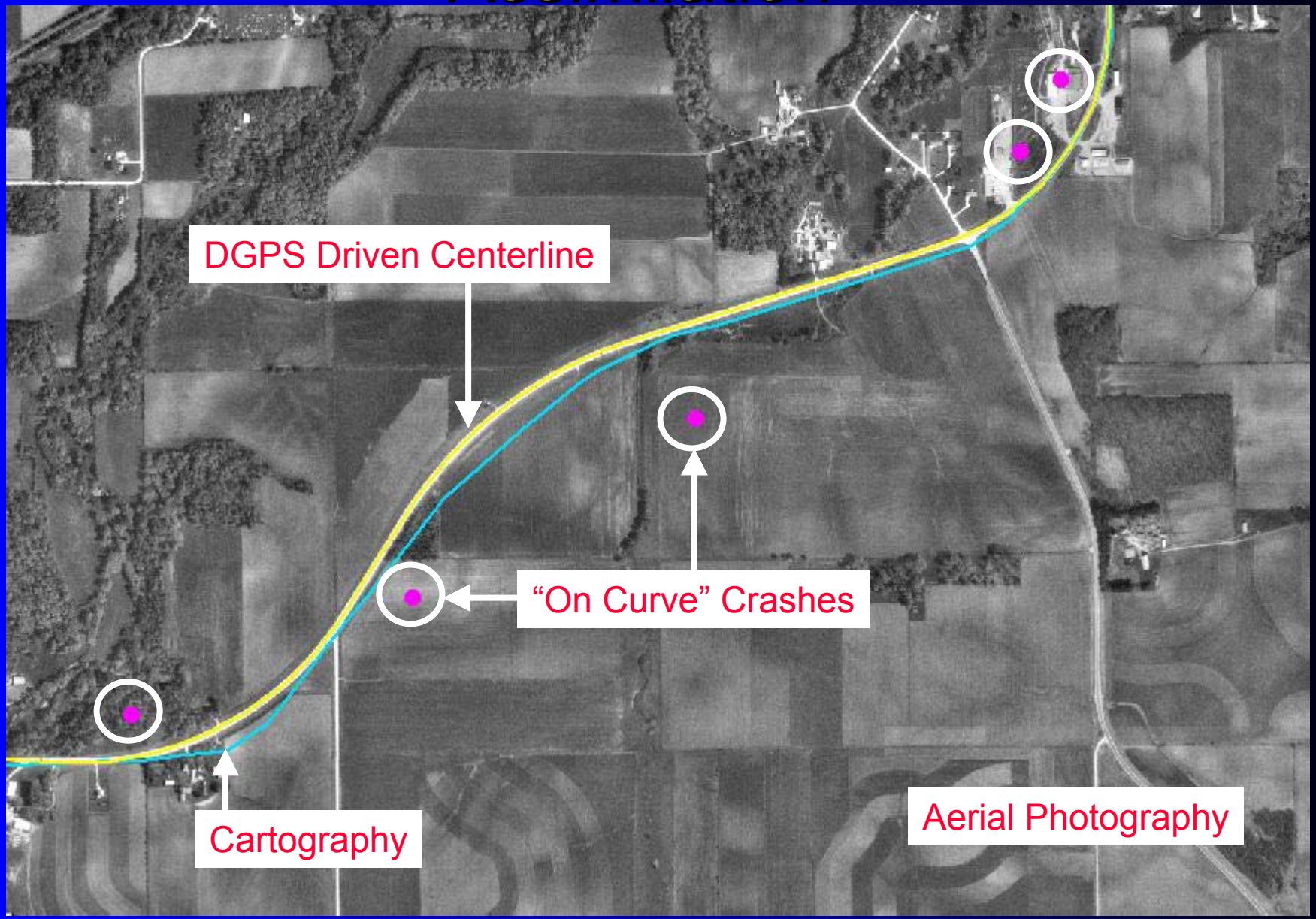
Study Topics



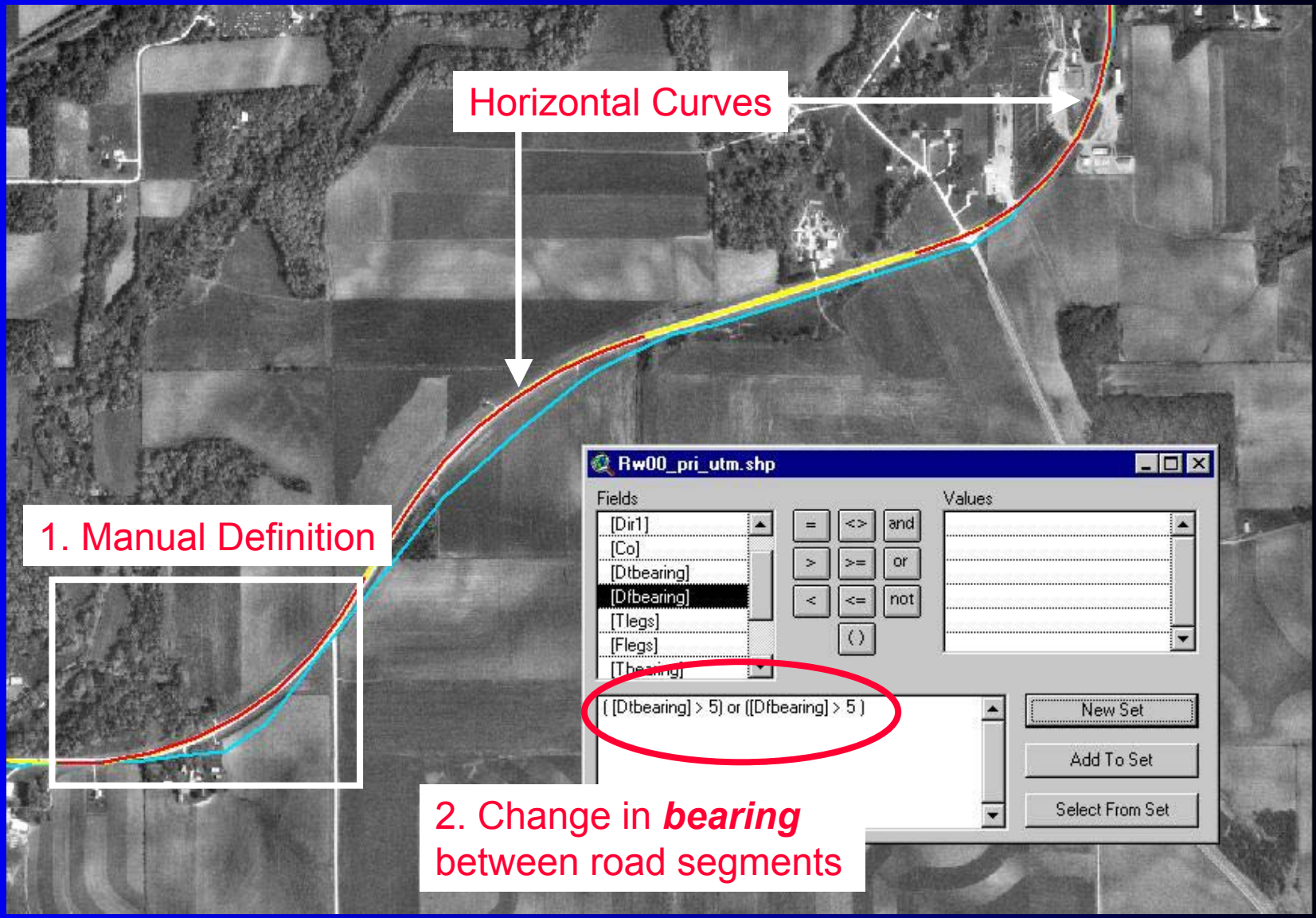
Type 1: Curve Methodology



Type 1: Curves – Existing Data Assimilation



Type 1: Curves – Identification & Creation of Horizontal Curve GIS



Type 1: Curves – Calculation of Curve Parameters

Derived from new horizontal curves GIS

$$L = 2R\theta$$

$$\frac{C}{2} = R\sin\theta;\ \text{see triangle xyz}$$

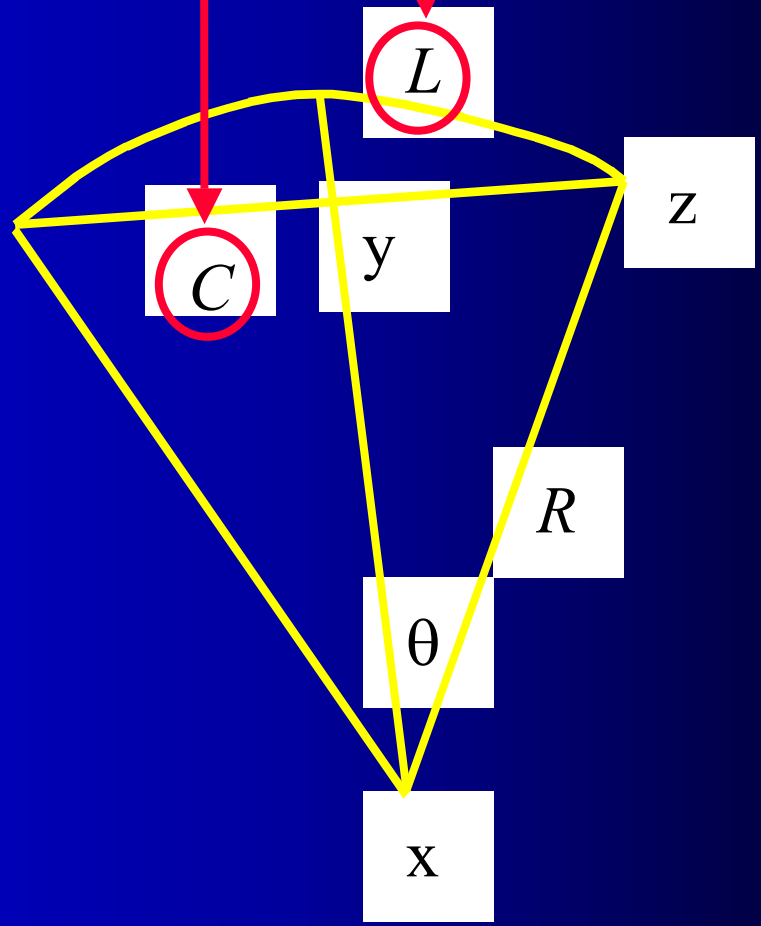
$$\frac{C}{L} = \frac{\sin\theta}{\theta}$$

$$f(\theta_n) = \frac{\sin\theta_n}{\theta_n} - \frac{C}{L}$$

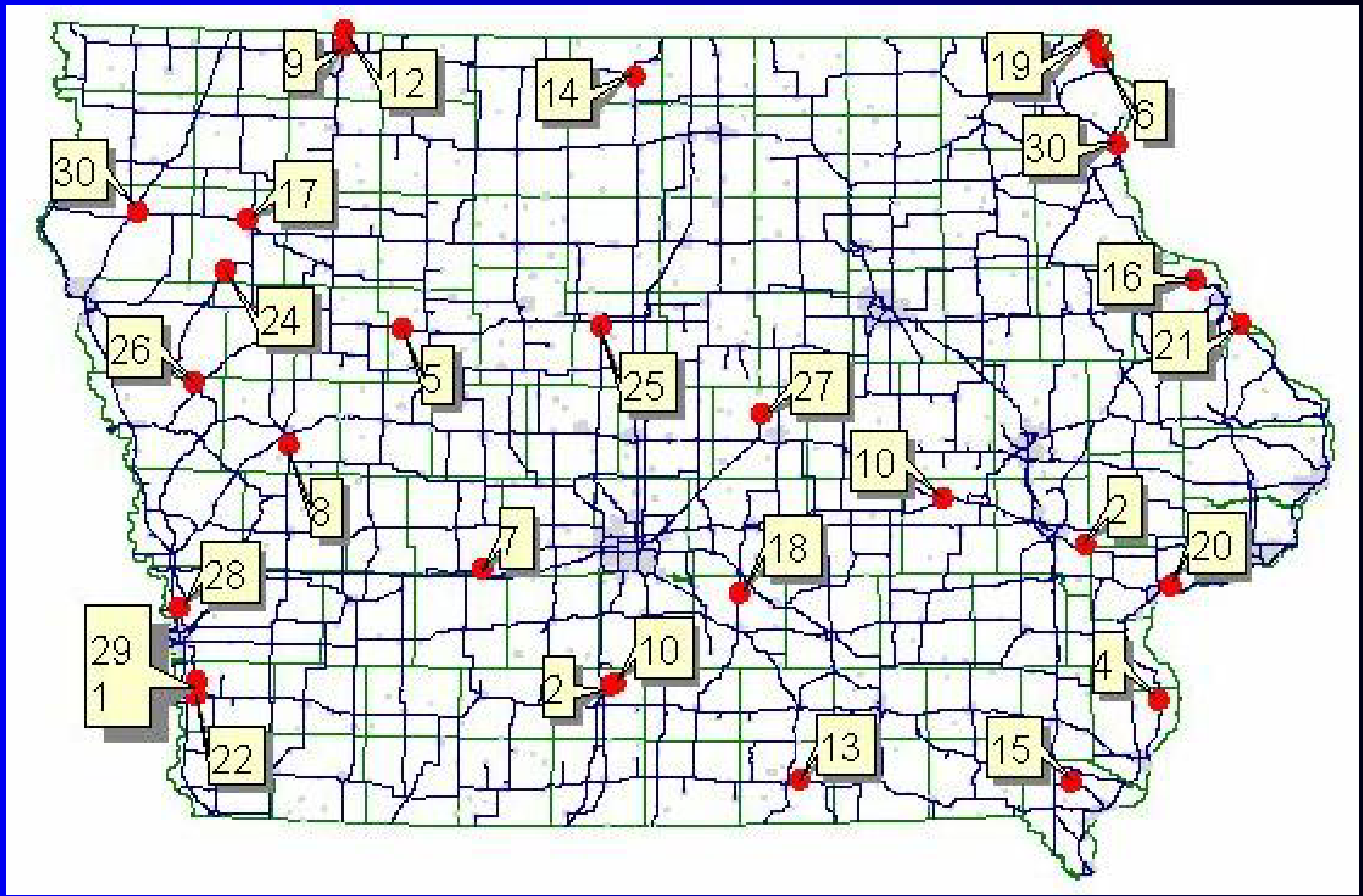
$$f'(\theta_n) = \frac{\cos\theta_n}{\theta_n} - \frac{\sin\theta_n}{\theta^2{}_n}$$

$$\theta_{n+1} = \theta_n - \frac{f(\theta_n)}{f'(\theta_n)};\ n = 0, 1, 2, \ldots$$

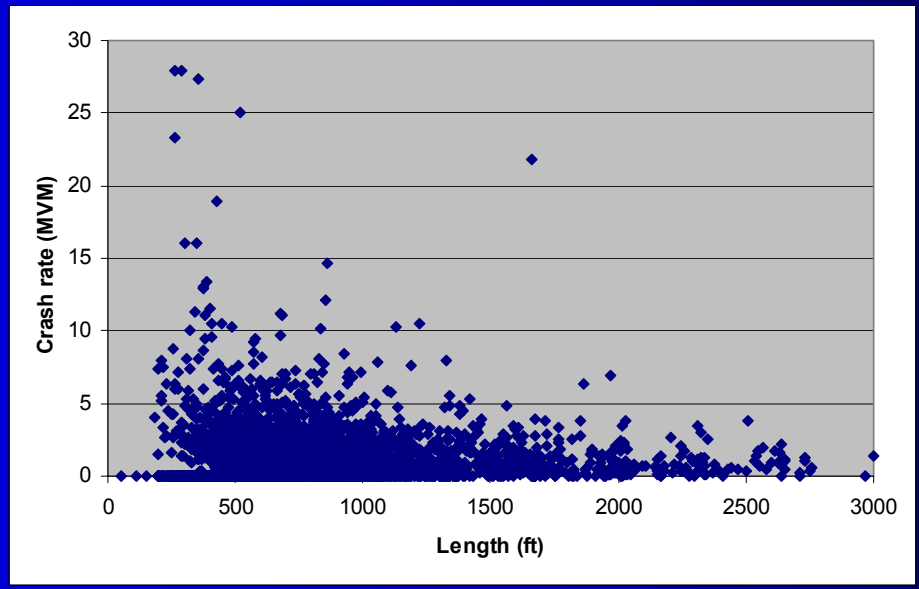
$$D = \frac{5729.579}{R}$$



Type 1. Curves – Ranking



Type 1. Curves – Statistical Analysis



Primary Roads Statewide (~ 2,000 curves with two or more crashes in 10 yrs)

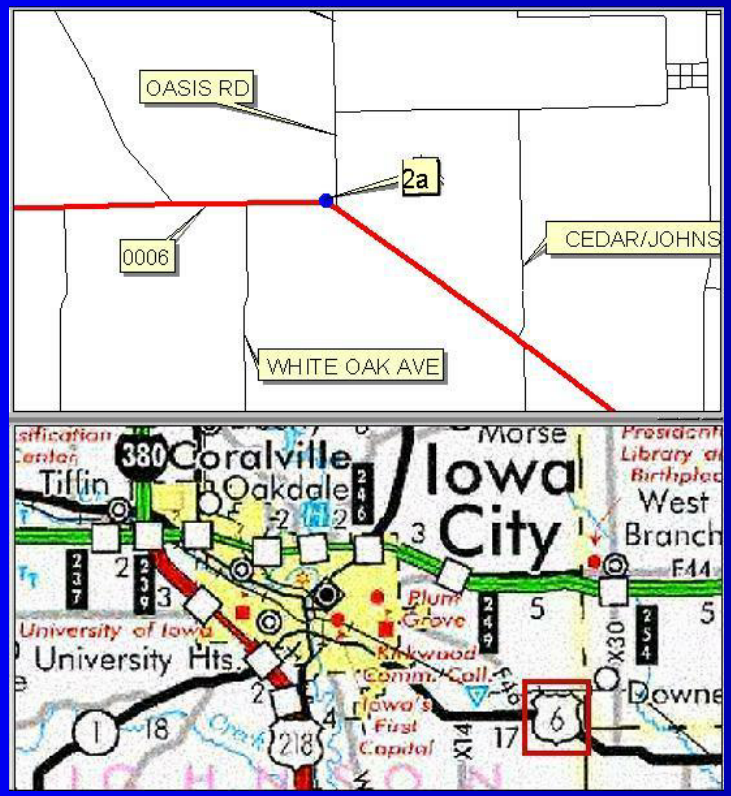
- **Statewide average = 1.1 / MVM (avg radius = 2850 ft., avg length = 870 ft.)**
- **Top 30 average = 11.7 (7.2*) / MVM (avg radius = 1780 ft., avg length = 807 ft.)**
- **Worst (of top 30) = 78 / MVM**
- **5% of crashes occur at top 30 locations (1% of curves)**
- **11% of fatalities occur at top 30 locations**
- **Curve length and degree of curvature are significant causal variables.**

* Weighted average

Type 1. Curves – Adjustment

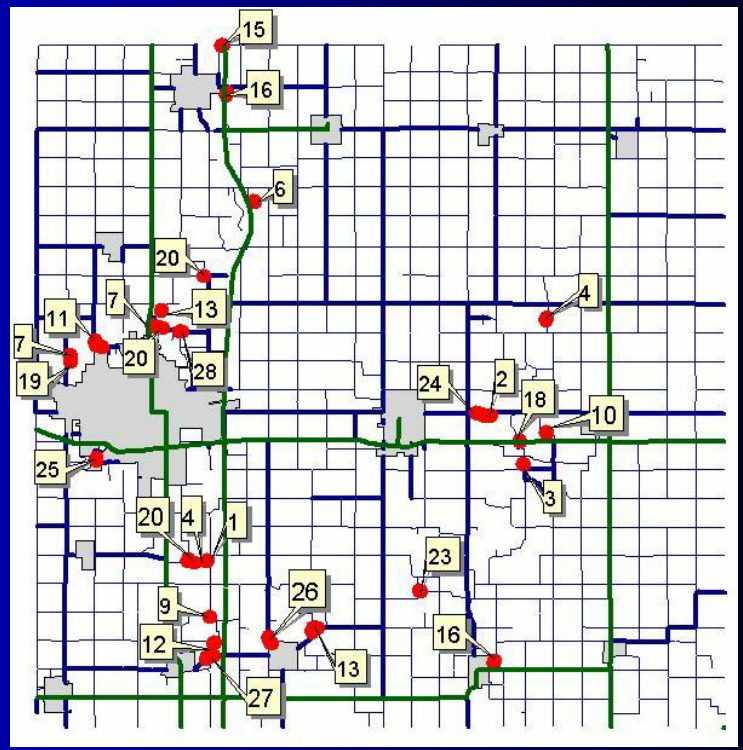
Should the three curves be analyzed as one?
Are the crashes caused by the overpass icing?

Type 1. Curves – Validation/Education

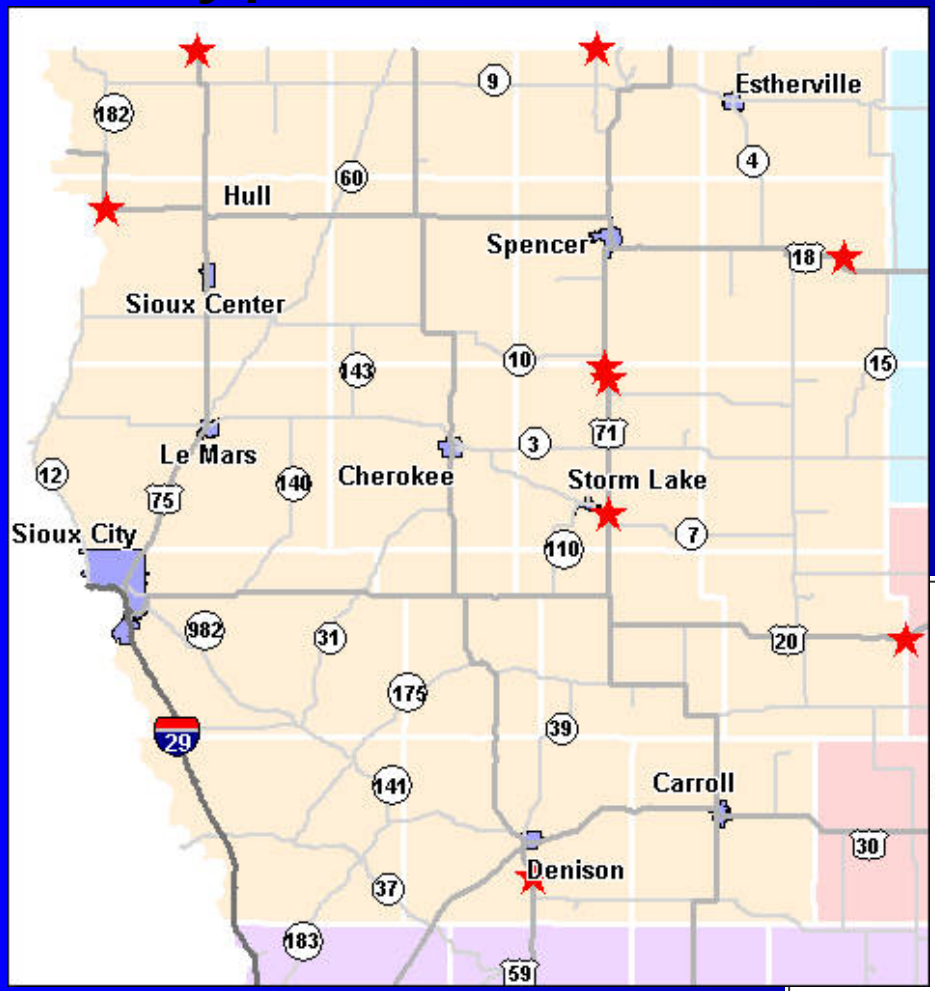


Primary Highways

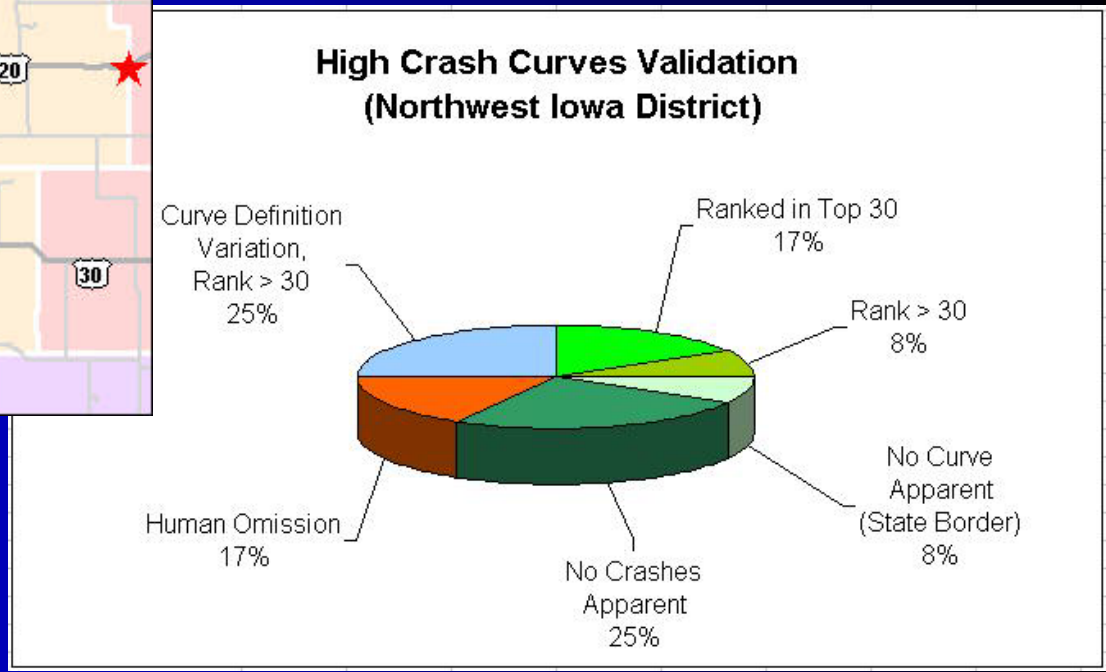
Story County Roads



Type 1. Curves – Validation/Education



Results changed where animal crashes were removed, e.g., curve #24, 18/23 were animal related

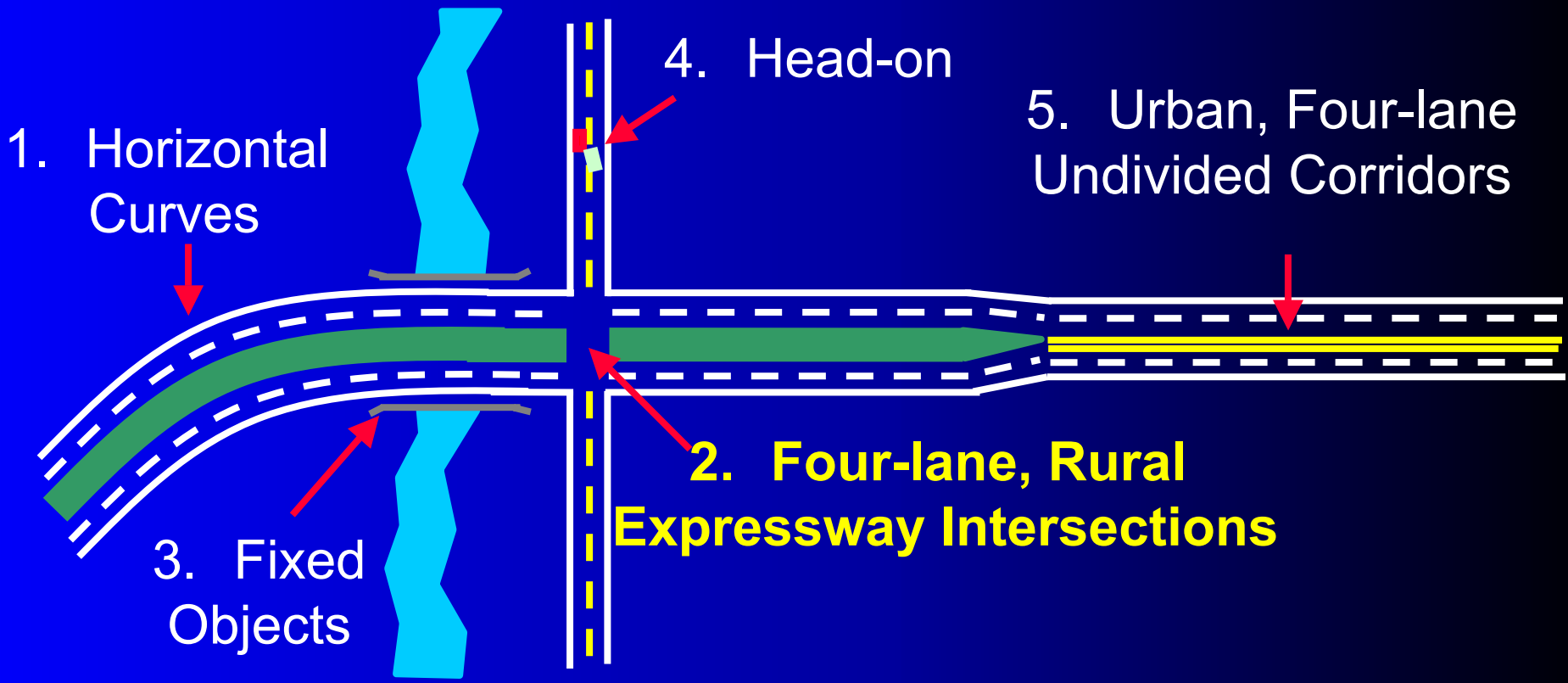


Type 1. Curves – Application of Low Cost, Corrective Measures

3rd highest statewide curve crash location

?

Study Topics



Type 2. Rural Expressway Methodology

Define Rural Expressways [GIMS Cartography]

Identify Intersection Crashes [ALAS]

Expert Opinion

A

V,E

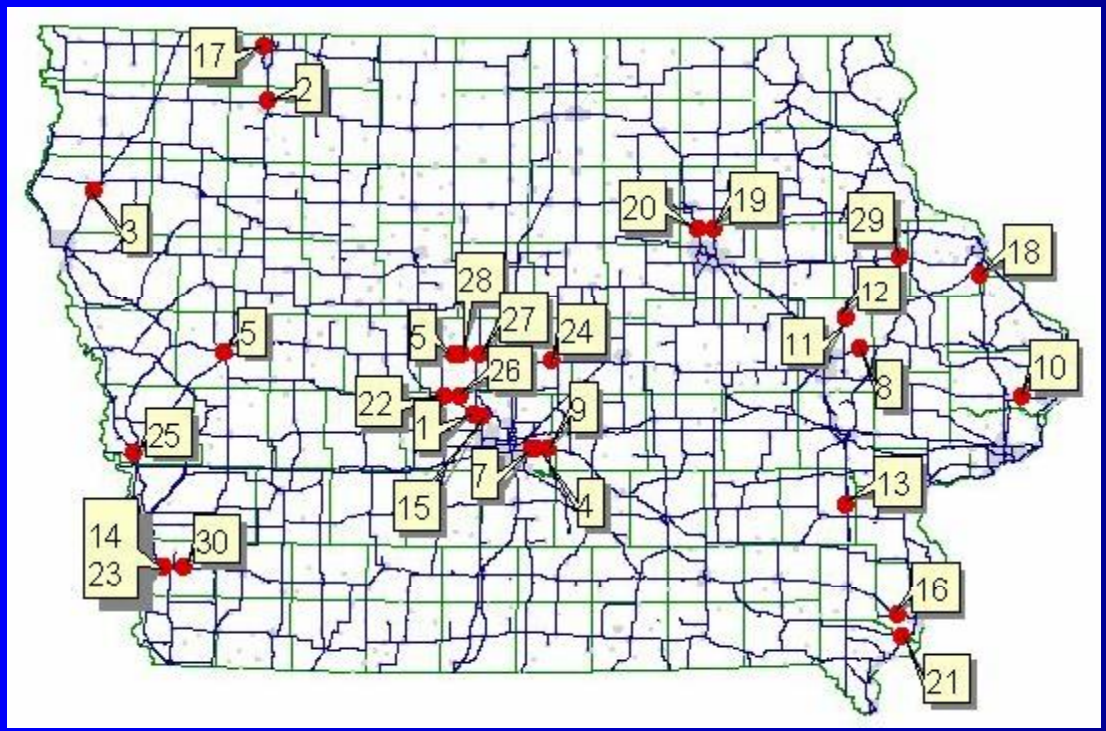
Identify Rural Expressway Intersections (REIs) [ALAS] [GIMS Cart.]

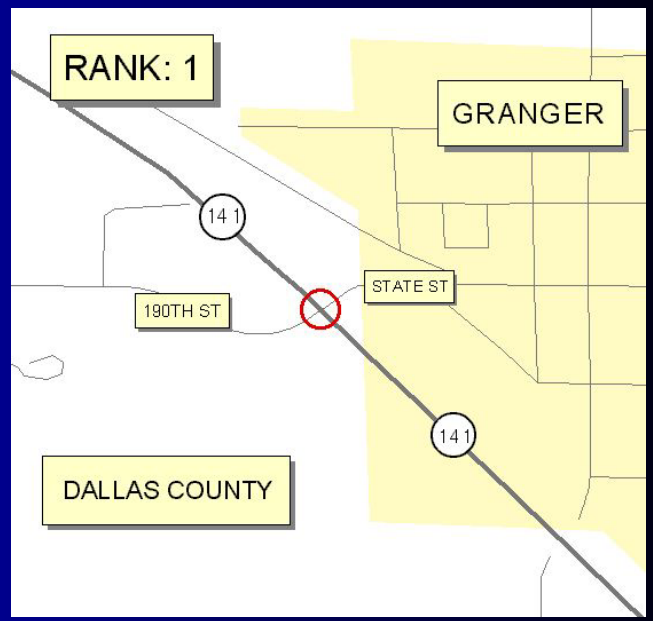
Identify Crashes at REIs

Derive DEV [GIMS Cart.]

Rank Locations (Freq,Sev,Rate)

Type 2. Rural Expressway Intersections

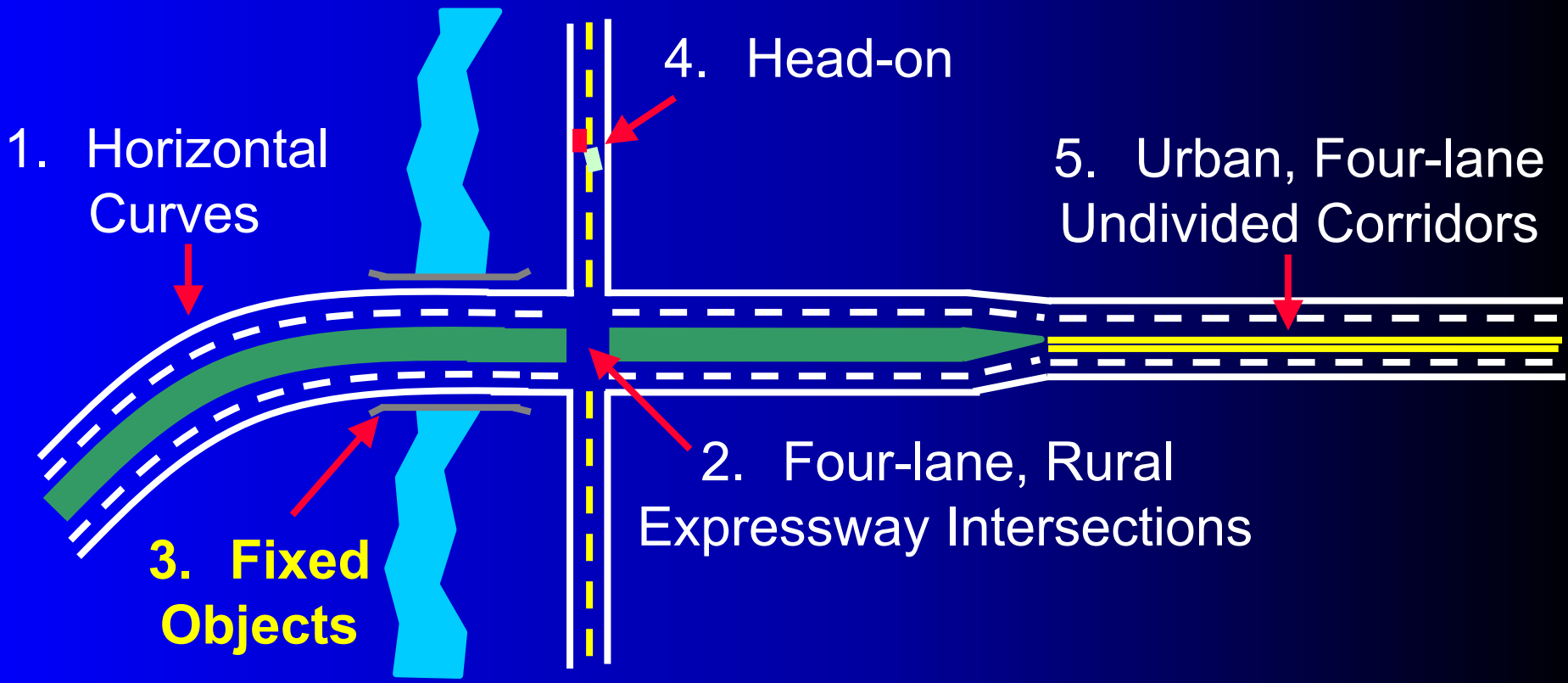




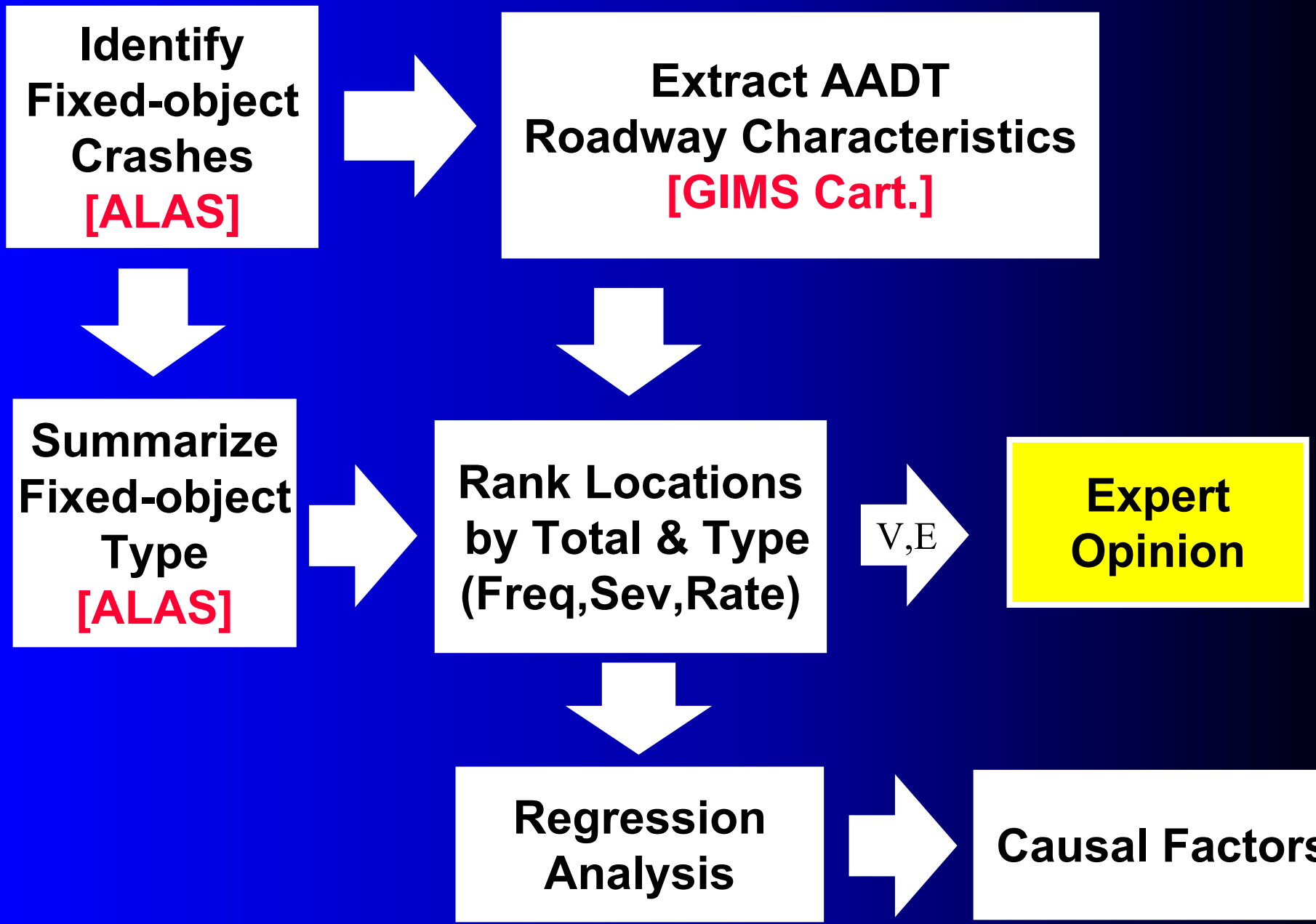
Primary Roads (~350 Intersections -- Statewide)

- **Statewide average = 0.24 / MEV**
- **Top 30 average = 0.76 / MEV (Worst = 1.62 / MEV)**
- **35% of crashes occur at top 30 locations (9.2% of locations)**
- **81% of fatals occur at top 30 locations**

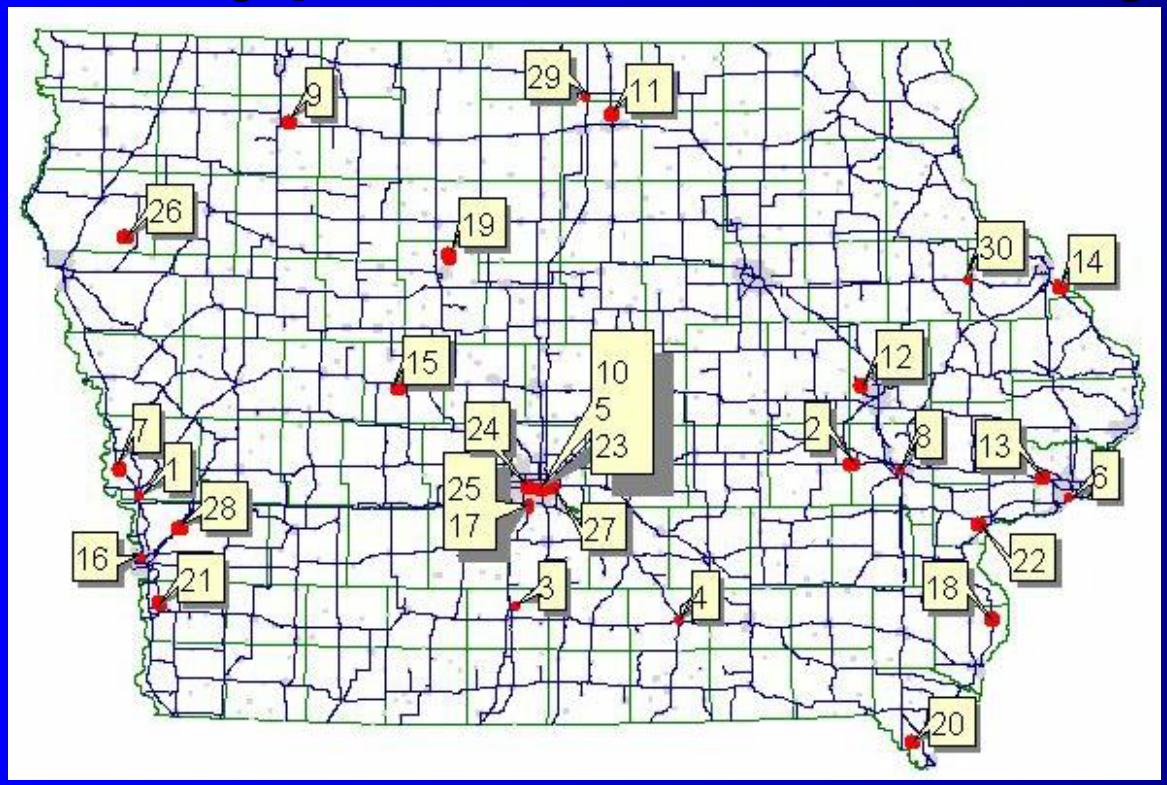
Study Topics



Type 3. Fixed-object Methodology



Type 3a. Fixed-Object Results

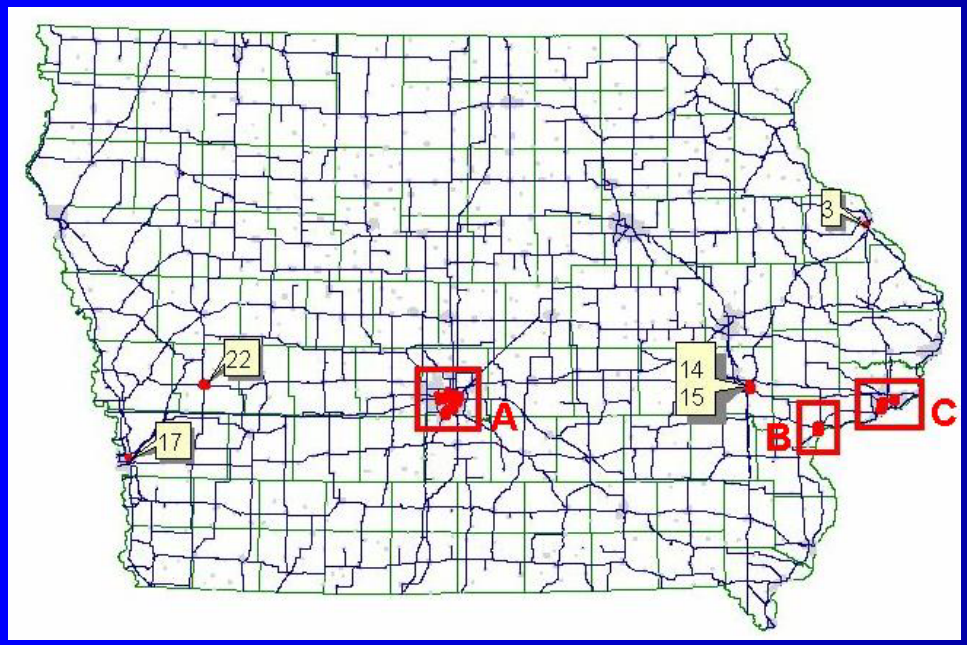


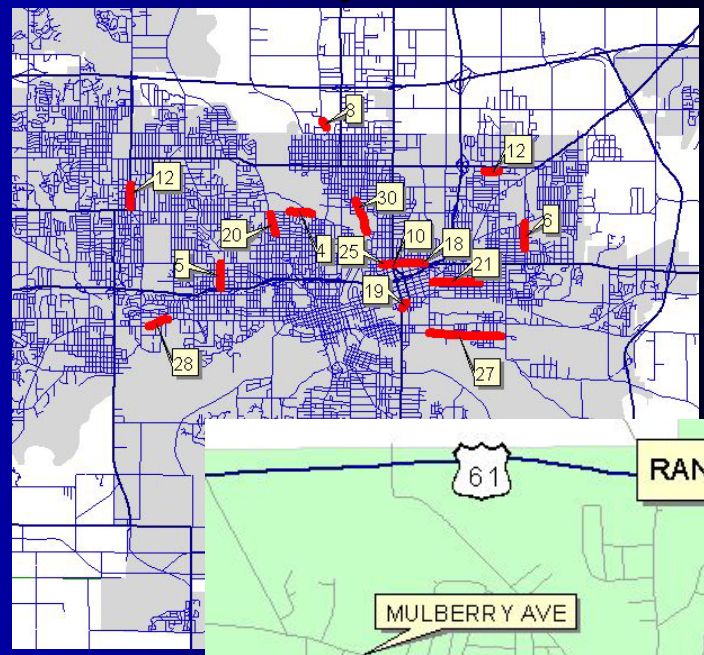
Primary, Secondary, Municipal Roads (Statewide)

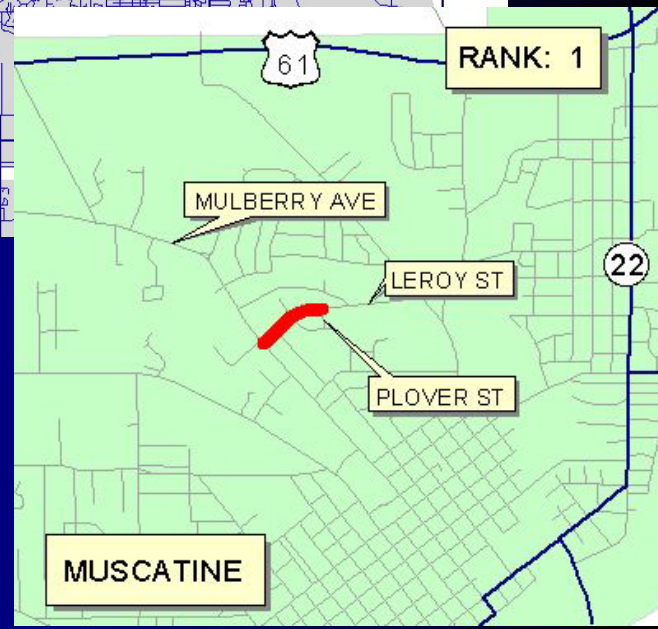
- **Statewide average = 0.50* / MVM**
- **Top 30 average = 25.5 (7.7*) / MVM (Worst = 167 / MVM)**
- **0.6% of crashes occur at top 30 locations (0.07% of locations)**
- **1.6% of fatals occur at top 30 locations**

*** Weighted average**

Type 3b. Fixed-Object Results (Utility Pole Struck)







Primary, Secondary, Municipal Roads (Statewide)

Statewide average = 0.28 / MVM

- **Top 30 average = 1.1 / MVM (Worst = 4.6 / MVM)**
- **3.9% crashes occur at top 30 locations (0.7% of loc.)**
- **6.5% fatals occur at top 30 locations**

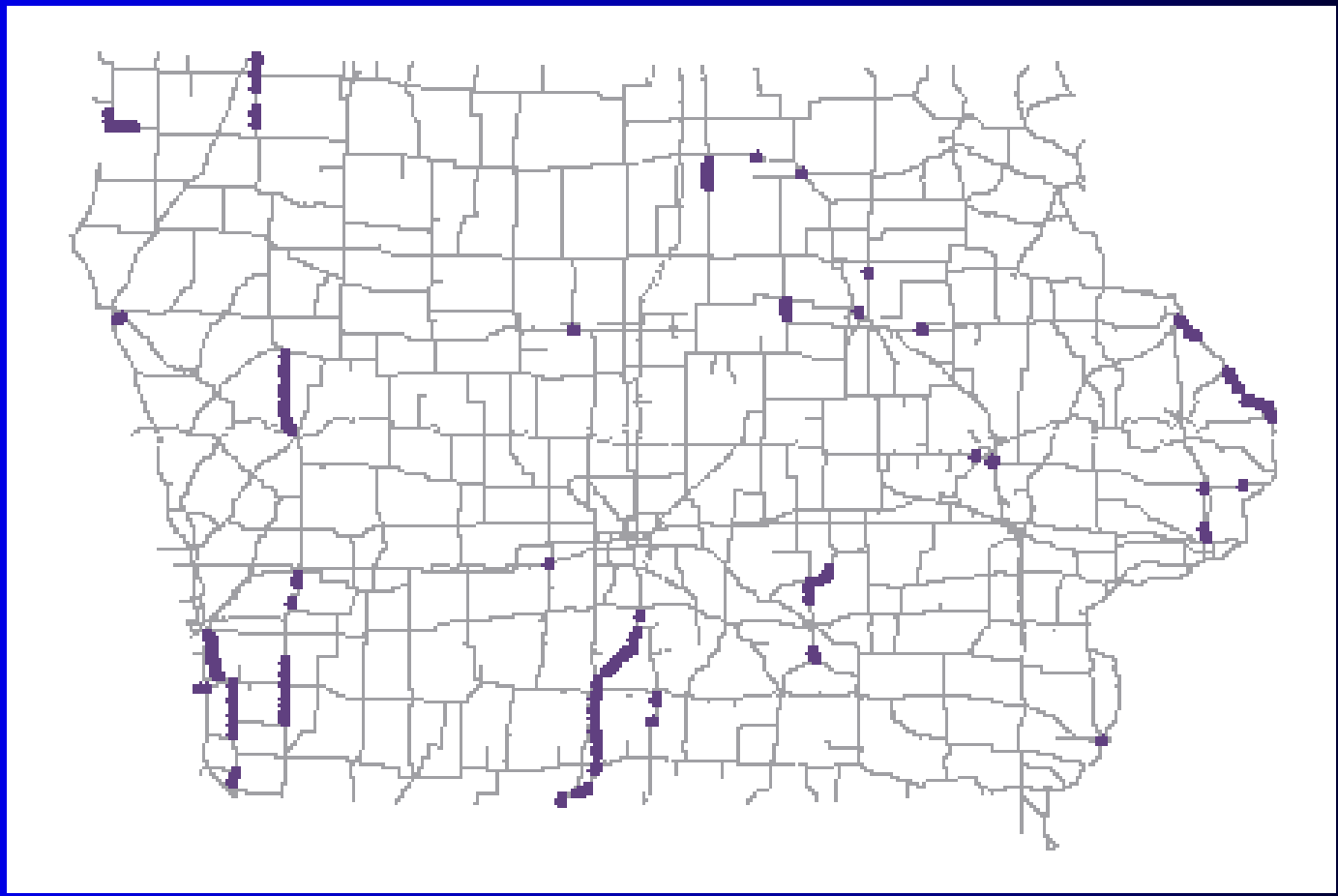
•* Weighted average

Type 3. Fixed-Objects Struck … Important Factors

- Interstate: terrain, pavement type, barriers
- US Hwy: barriers and surface width
- Other Primary: terrain, pavement
- Farm: shoulder & pavement type
- Local: terrain, pavement, #lanes, speed limit

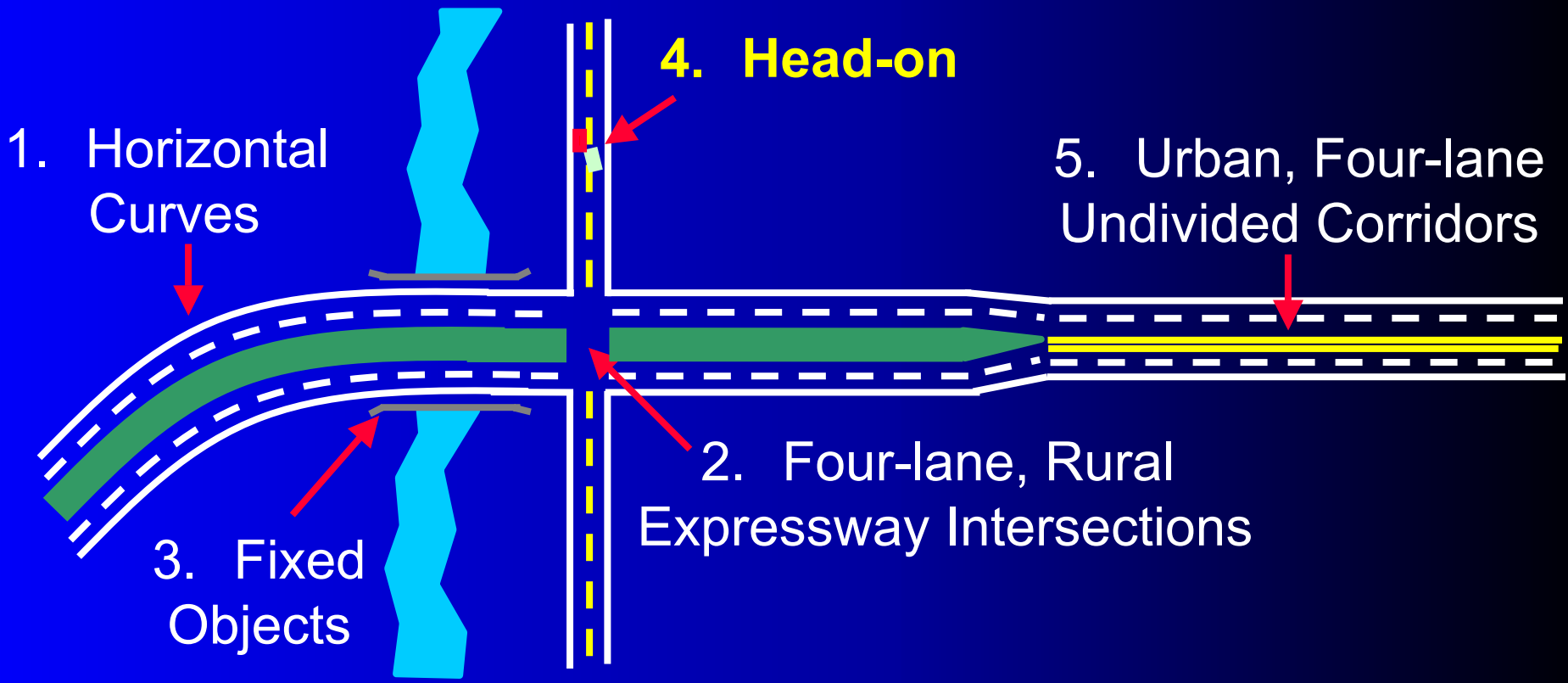
… and, as expected, functional class matters

Type 3. Potential Fixed-Object Problem Locations

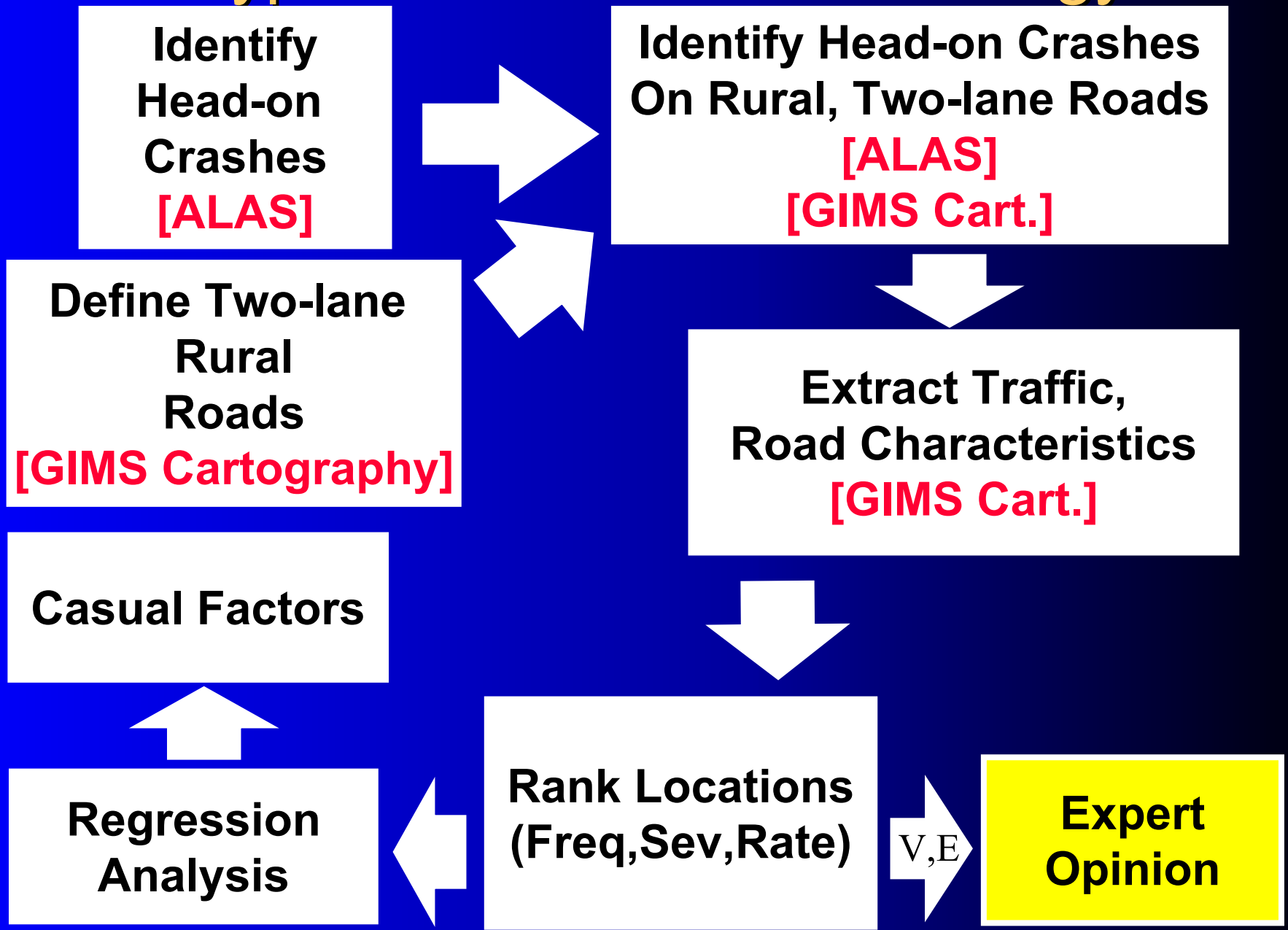


US Highways, No Median Barrier, Narrower Surface Widths

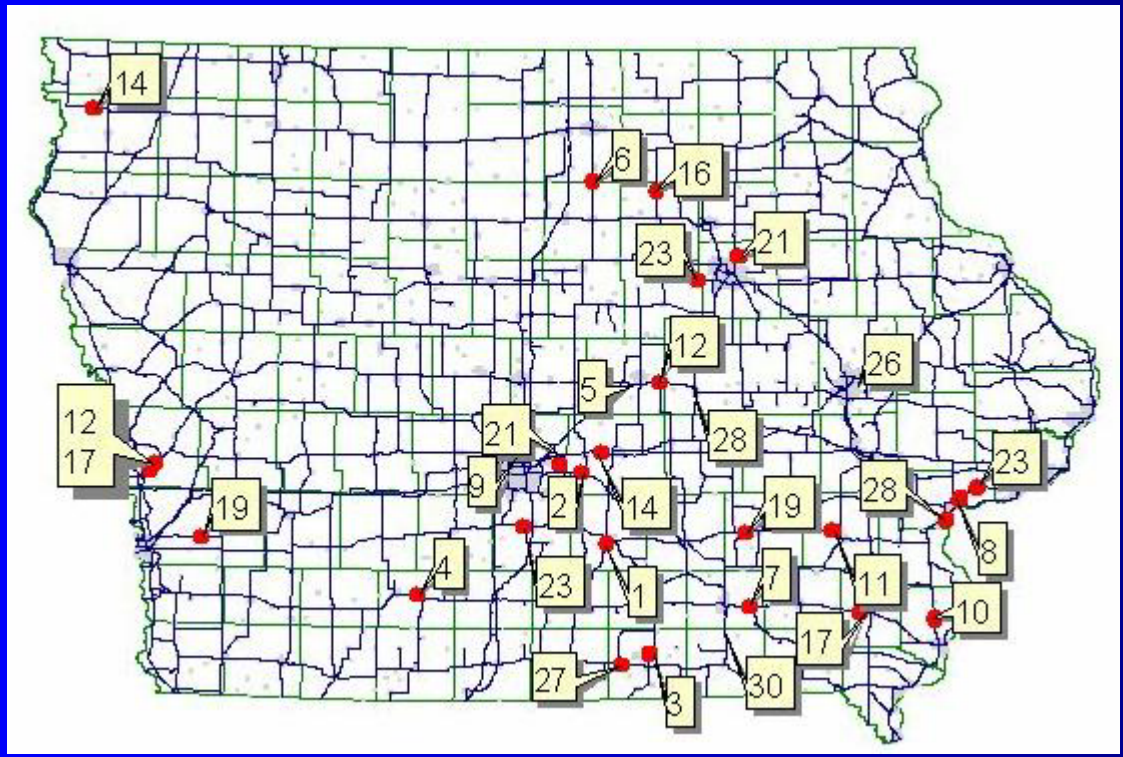
Study Topics

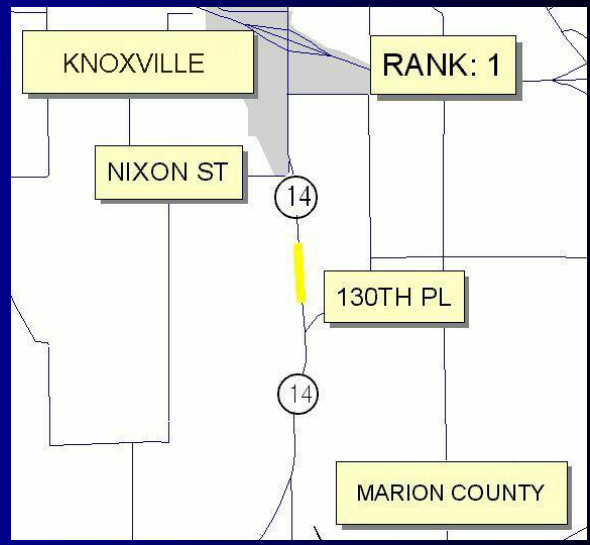


Type 4. Head-on Methodology



Type 4. Head-on Results





Rural, Two-lane Paved Roads (Primary and Secondary - Statewide)

- **Statewide average = 0.21 / MVM**
- **Top 30 average = 0.91 (0.37*) / MVM (worst = 11.9 / MVM)**
- **3.1% of crashes occur at top 30 locations (0.9% of locations)**
- **6.4% of fatals occur at top 30 locations**

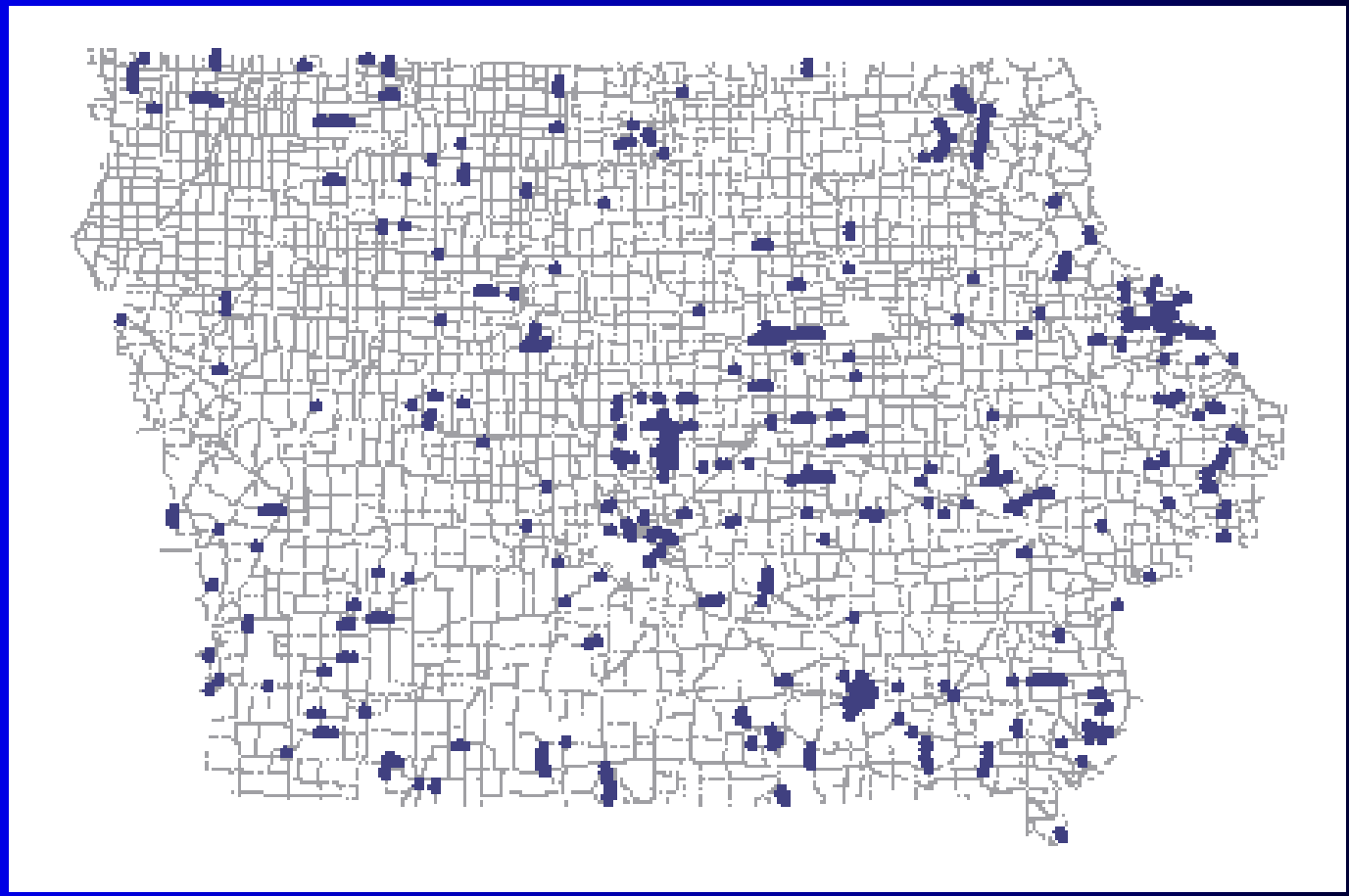
*** Weighted average**

Type 4. Head-on Collisions … Important Factors

- US Hwy: terrain, shoulder width, speed limit
- Other Primary: speed limit, shoulder width, IRI
- Farm: shoulder width and paved shoulders

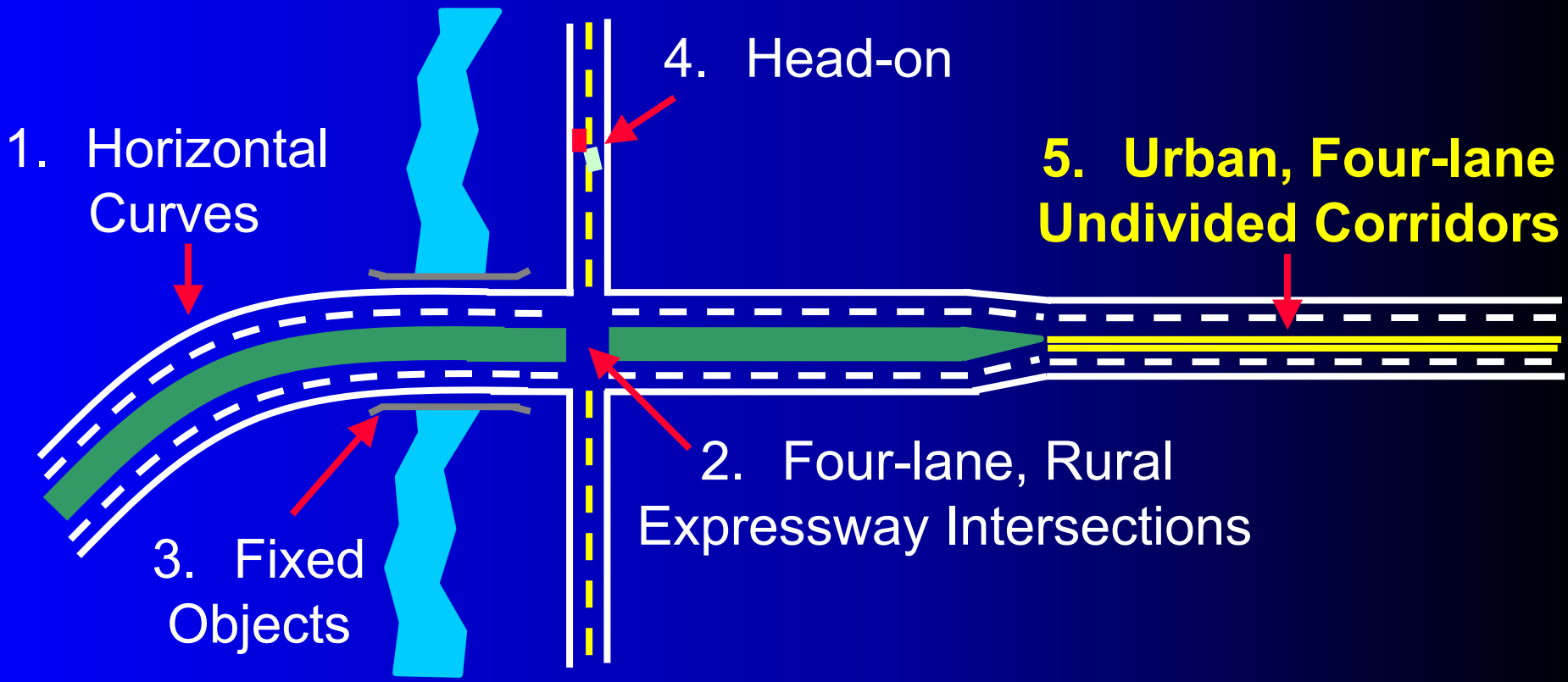
… and, as expected, functional class matters

Type 4. Potential Head-on Problem Locations

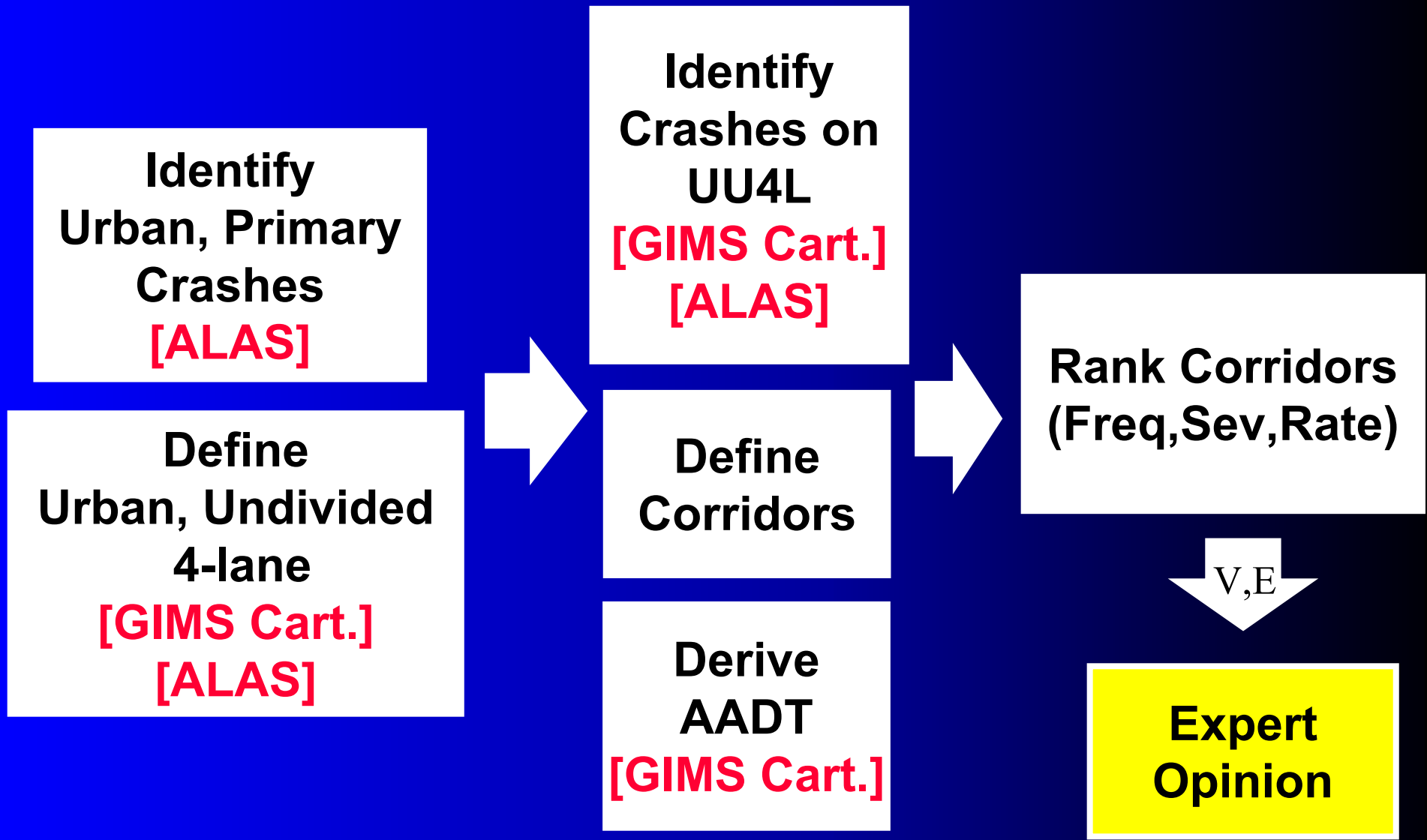


Farm-to-Market, Unpaved, Narrow Shoulders

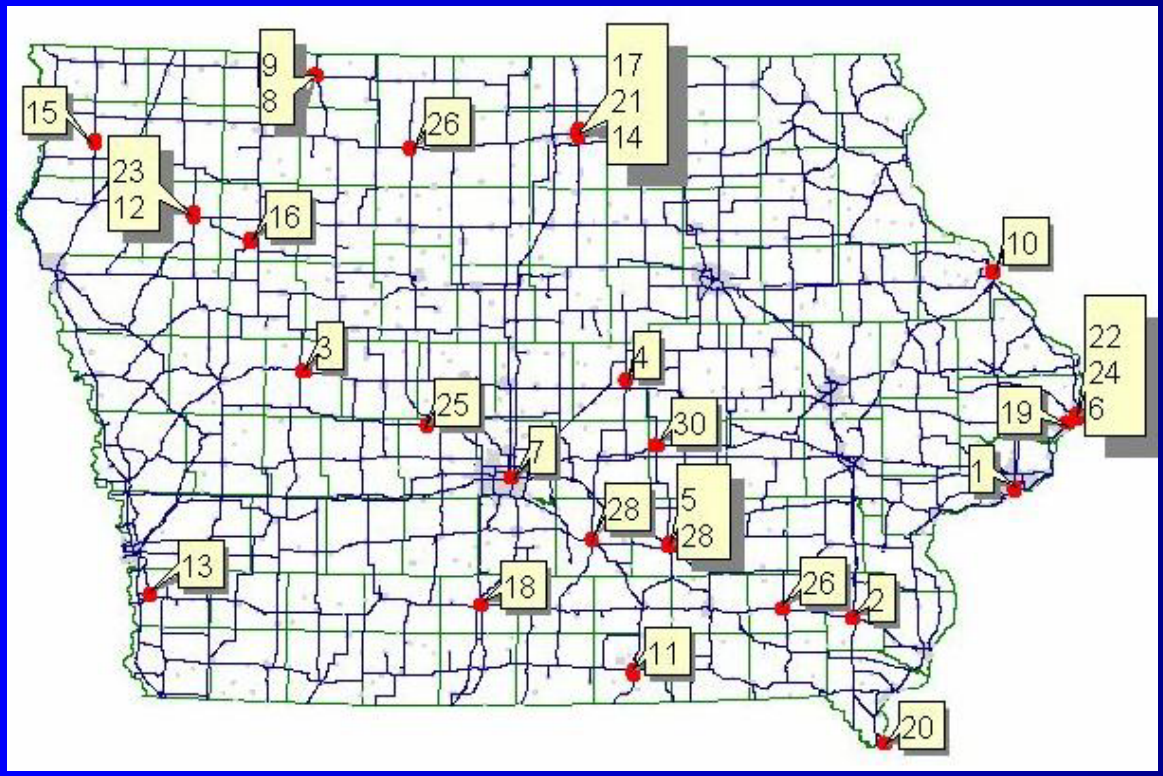
Study Topics

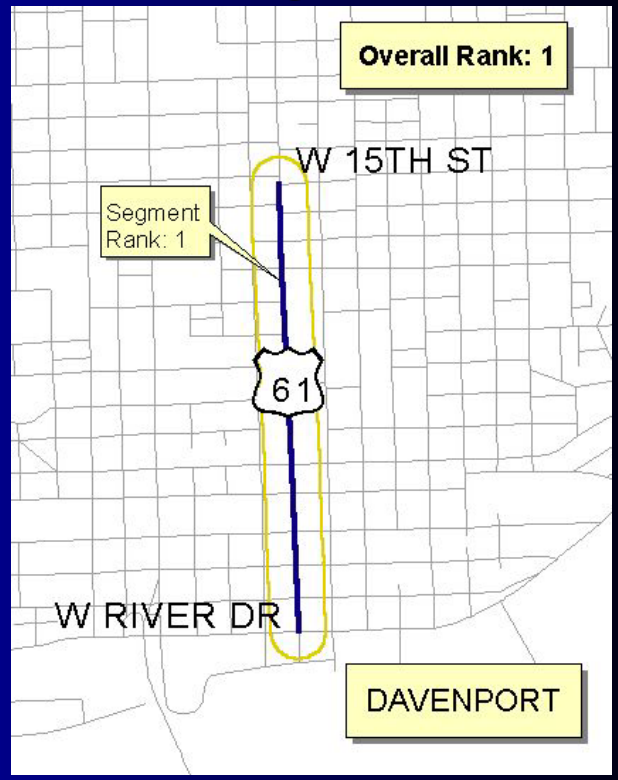


Type 5. Undivided, 4-lane Methodology



Type 5a. Undivided, 4-lane Segments



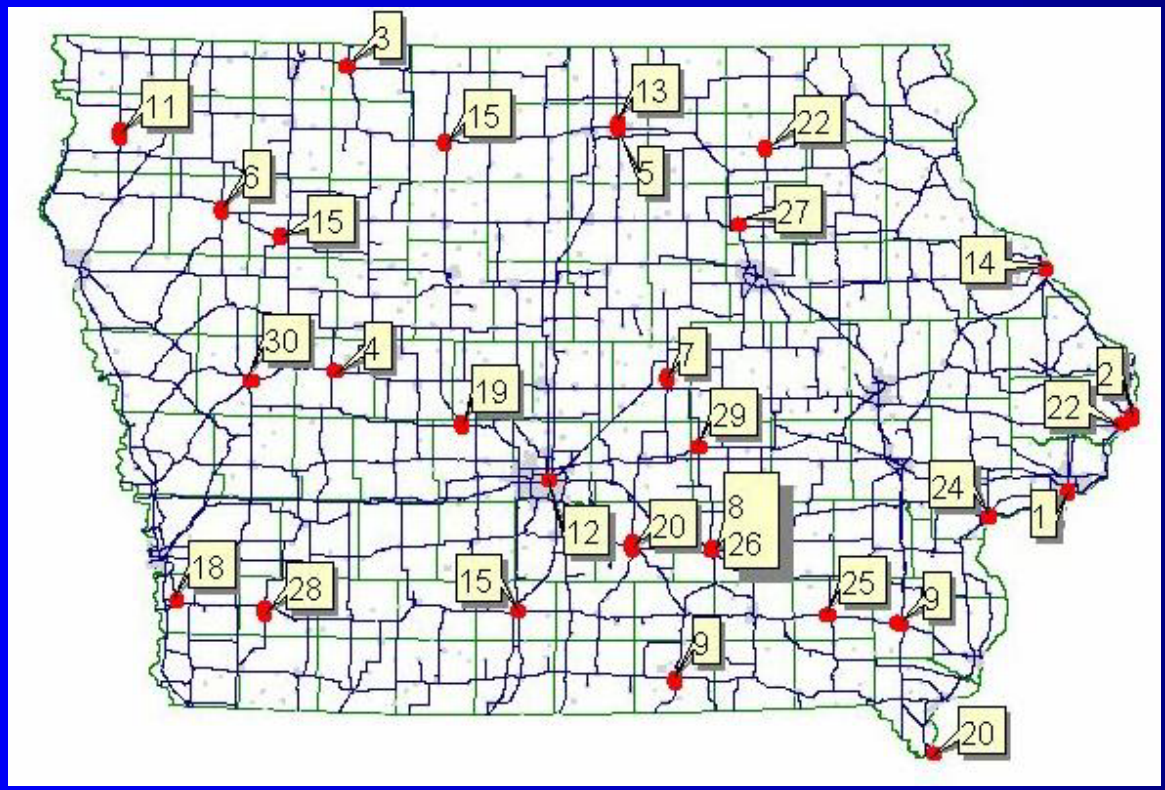


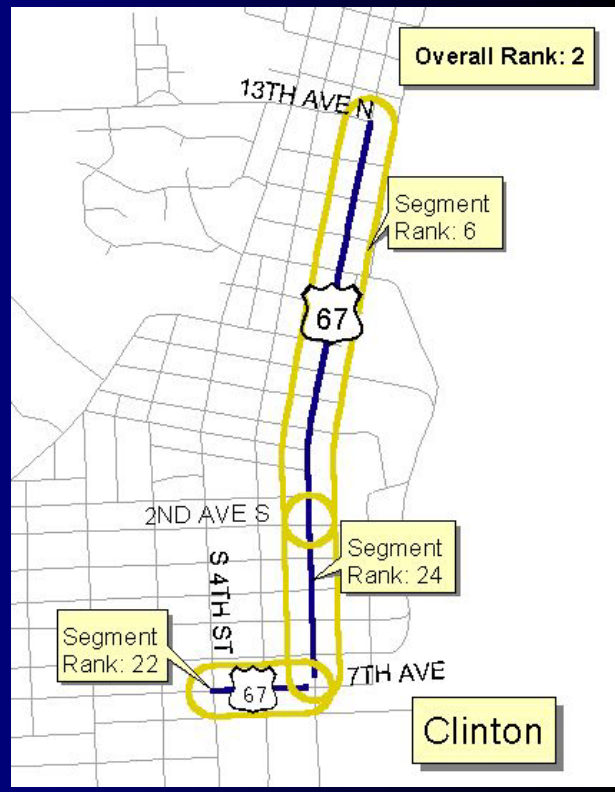
Urban, Primary (Statewide, includes intersection crashes)

- **Statewide average = 10.0 / MVM**
- **Top 30 average = (12.3*) / MVM (worst = 50.7 / MVM)**
- **65% of crashes occur at top 30 locations (46% of locations)**
- **71% of fatals occur at top 30 locations**

*** Weighted average**

Type 5b. Undivided, 4-lane Corridors





Urban, Primary (Statewide , includes intersection crashes)

Statewide average (primary) = 4.4 / MVM

- **Top 30 average = (10.6*) / MVM (worst = 18.4 / MVM)**
- **84% of crashes occur at top 30 locations (75% of locations)**
- **58% of fatals occur at top 30 locations**

*** Weighted average**

Project Benefits

- More Systematic Approach to Identify Existing and Potential High Crash Locations
- Additional Safety Tool in Safety Toolbox
- More Efficient Use of Funding for Safety Improvements
- Allows More Proactive Approach

Thank you

- Questions?

- For more info …
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- 294-5453